

Floristic Survey of a Highly Disturbed Wetland within Shaker Median Park, Beachwood (Cuyahoga County), Ohio¹

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ABSTRACT. A 1.5 year-long investigation of a highly disturbed suburban wetland revealed 298 species, varieties, and formas of vascular plants, including several taxa uncommon elsewhere in Cuyahoga County. The site exhibited five vegetation subtypes which we compared using several measures including Floristic Quality Assessment Index and Shannon Diversity Index. Historically, the site has been subjected to numerous massive disturbances, but none in a period of 20 years from ca. 1982-2002. Data indicated that the site had recovered partially from disturbance, but was threatened by invasive species.

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INTRODUCTION

Many attempts have been made to describe the Ohio flora, beginning with those of European explorers and surveyors in the late 18th century. Amzi Atwater, a subordinate of Moses Cleaveland, undertook early surveys within Ohio and described forest types in his journals (Atwater 1797). More recently, workers have begun to assess floras of urban and suburban areas in both the US (Aronson and others 2004; DeCandido 2004; DeCandido and others 2004; Wilder and McCombs 1999) and in Europe (Dana and others 2002; Wittig 2002). Many of the studies, aforementioned, yielded "baseline" information that may facilitate assessment of community change over time (including consequences of urban development and the introduction of exotic invasive species).

Most previous floristic surveys were of pristine natural areas, or at least of tracts manifesting unquestioned environmental and/or aesthetic value; however, the value of urban green space for preserving plant diversity was not widely recognized.

Herein, we describe plant diversity within an isolated, small, disturbed portion of Shaker Median Park, a tract of green space within Beachwood, OH, that was barred from public use at the time of the study. The City of Beachwood plans to convert part of this tract, including our study site, into parkland accessible to the public. Data from our investigation will constitute a baseline for monitoring future change.

Site Description

Shaker Median Park is located in Beachwood, OH, a suburb of Cleveland. Our study site comprises the western half of Shaker Median Park. The center of the study site is at, approximately, 41°28'42" north latitude, 81°30'20" west longitude. Shaker Boulevard West, Richmond Road, Shaker Boulevard East, and the Beachwood/Shaker Heights boundary comprise the

northern, eastern, southern, and western borders of the site, respectively (Fig. 1). The site occupies 11.03 ha and is 0.795 km long and 150 m wide. Three regions compose the site: upland to the north, a large basin in the center, and upland to the south.

Located on a ridge within the glaciated Allegheny Plateau, the study site includes parts of the Chagrin River watershed, the Doan Brook watershed and, to a small extent, the Euclid Creek watershed.

Average high temperature for the area is 14.67°C, average low temperature is 4.72°C; 93.04 cm of rain annually are normal. April 21 is the average date for the last occurrence of 0°C temperature during spring; October 29 is the average date for the first incidence of 0°C temperature in fall (Bray 2003).

Soil at the study site is a loamy udorthent (*Ua* in the soil

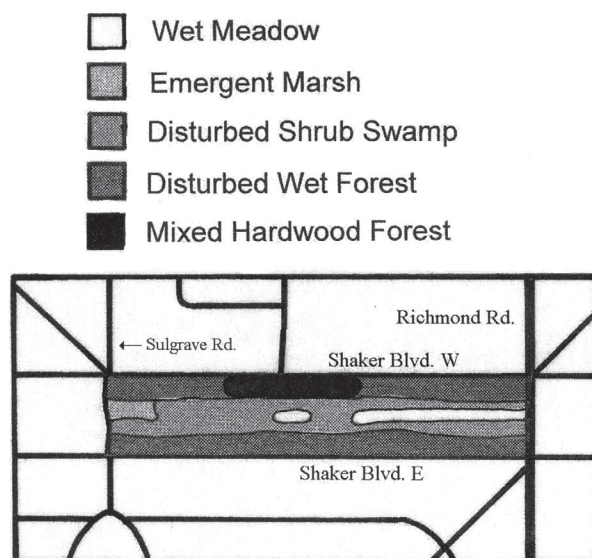


FIGURE 1. Map of site showing vegetation subtypes. Study site is bordered by Richmond Road (east), Shaker Heights border (west), westbound Shaker Boulevard (north), and eastbound Shaker Boulevard (south). Subtypes are color-coded to subtype, as listed above. Legend does not apply to areas outside of the study area.

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series; Musgrave and Holloran 1980). This kind of soil may consist of clays, sand, topsoil, fill, rock fragments, ash, or other materials, and has been disturbed to such an extent that distinct horizons are no longer intact. Soil chemistry and soil borings undertaken at the site reveal that the soil is alkaline, rich in calcium, poor in phosphorus and potassium, and has one to several silty clay layers that cover shale bedrock.

Site History

The area now known as Beachwood, OH, was once part of the Connecticut Western Reserve. The first survey of the Western Reserve was completed in 1797. Unpublished, handwritten reports by surveyors showed the north line of plot 39 (which corresponds to the east-west axis of the study area) to be forested, with maple (*Acer* spp.), linden (*Platanus* sp.), white ash (*Fraxinus americana*), beech (*Fagus grandifolia*), chestnut (*Castanea* sp.), and elm (*Ulmus* spp.) trees present (Atwater 1797). After settlement by Europeans, the area was used for farming (Stranahan 1903). In the 1920s, real estate magnates Mantis and Oris Van Sweringen developed the site to be part of an extension of their Shaker Rapid System (Morris 1997). This development included excavating a channel in which the tracks would be laid, and building a bridge over this channel for automobile traffic (Fig. 2). Essentially, all vegetation was removed from the site at this time, as well as most of the soil from the central portion of the site. In 1982, the bridge over the channel was replaced with fill material (primarily soil, clay, and ash), upon which the road was rebuilt. This was the last major disturbance to the site at the time of the study.

MATERIALS AND METHODS

Plant specimens were collected during two growing seasons, from April 2001 to October 2002. Two independent teams of researchers undertook collecting: Wilder and Ms. Martha McCombs (during 2001) and DeLong and Jog (during 2001-2002). Plant materials were pressed, dried, and prepared as standard herbarium specimens. Specimens were deposited permanently as one collection at the Cleveland Museum of Natural History (CLM; accession number 2003-14).



FIGURE 2. Photograph (ca. 1978) facing east showing the Richmond Road bridge (now replaced by earthworks). Note the sparse nature of the vegetation in the foreground (due to the 1929 disturbance and subsequent maintenance) even before the final major disturbance in 1982. (Photo courtesy of ODOT.)

Most collections were identified to species (and to variety when possible); however, relatively few specimens, that is, ones lacking characteristics essential for species identification, were identified to genus but not to species. Identifications of problematical specimens were verified by Dr. James Bissell, Dr. George Argus, and Mr. Charles Tubesing.

Nomenclature mainly follows Kartesz (1999), with these exceptions: *Rhamnus frangula* L. var. *asplenifolia* Dipp. (Rehder 1927); *Arctium minus* (Hill) Bernh. forma *pallidum* Farw., *Daucus carota* L. forma *epurpuratus* Farw., *Barbarea vulgaris* R. Br. var. *arcuata* (Opiz) Fries, and *Glechoma hederacea* L. var. *micrantha* Moric. (Fernald 1950); *Melilotus alba* Desr. (Weishaupt 1971); *Vitis labruscana* Bailey and *Physostegia alba* Benth. var. *alba* Hort. (Bailey 1949); *Spiranthes cernua* (L.) L.C. Rich sensu lato (Case 1987). Also, our material of *S. cernua* has characteristics of both *S. cernua* and *S. ochroleuca*.

In addition, we used the system of nomenclature from Magee and Ahles (1999) for *Crataegus* species. These authors combined many narrowly circumscribed species of *Crataegus* and utilized former names of tribes of *Crataegus* as specific epithets for their broadly defined species.

We obtained stereo pairs of aerial photographs of the study site, prepared in 1998, from the Ohio Department of Transportation Division of Aerial Engineers (scale = 1:1500; enlargement 1:375). Photographs were analyzed with a stereoscope, allowing recognition of different vegetation subtypes, different forest types, and even different ages of vegetation (Hamilton and others 1995). Community types delineated using aerial photos were ground-truthed in the field.

Quantitative studies were conducted during the 2002 growing season. Six transects were established at the study site; plots were delineated at regular intervals along each transect, and these plots were divided into subplots. Creation of subplots was according to the Relevé method (Mueller-Dombois and Ellenberg 1974). For herbs, subplot radii were 0.9 m, for shrubs 3.0 m, and for trees 9.1 m. We determined lengths and numbers of plots, using a species-area curve (Mueller-Dombois and Ellenberg 1974). We established one transect within each vegetation subtype except within disturbed wet forest, in which two transects were delineated (on the north side and south side, respectively) (Fig. 3).

We investigated transects three times during 2002. Also, a meander survey (random visual assessment of taxa) was undertaken to account for species observed outside of transects or at different times of year. We compiled percent cover data for transects by combining data from all relevés; thus, it is not uncommon for percent-cover values to exceed 100%. We calculated Shannon Diversity Indices (Ludwig and Reynolds 1988) and generated a cluster dendrogram (using Czekanowski's Index of Similarity; Pielou 1984).

We determined the floristic quality assessment index (FQAI) for each transect (Andreas and Lichvar 1995). This method assigns numerical values for the coefficient

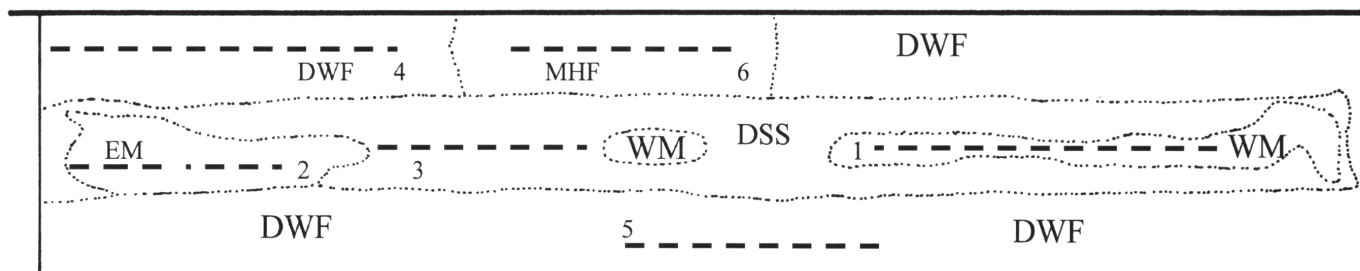


FIGURE 3. Diagram showing approximate locations of transects (dashed lines). Codes correspond to vegetation subtypes, as defined in the text: WM = wet meadow, EM = emergent marsh, DSS = disturbed shrub swamp, DWF = disturbed wet forest, MHF = mixed hardwood forest.

of conservatism (C of C) for individual plant species of northern Ohio. Coefficient values are defined: 0 = a species that is alien, invasive, or commonly found in highly disturbed areas; 1 to 3 = a species capable of growth in disturbed sites and exhibiting widely varied habitats; 4 to 6 = a species tolerating less disturbance and growing in more specific kinds of communities; 7 and 8 = a species tolerating little disturbance; 9 and 10 = a species tolerating very limited kinds of habitats with very little to no disturbance (Andreas and Lichvar 1995).

The FQAI was calculated using the following formula (I = the FQAI, R = sum of the C of C values for a given area, N = number of native species):

$$I = \frac{R}{\sqrt{N}}$$

Based upon examples cited by Andreas and Lichvar (1995), we defined individual areas with FQAI of 50 or higher as having extremely high quality, whereas, areas of 10 or less had low quality.

We recognize three categories of invasive plants with Ohio (Windus and Kroemer): 1) Targeted species—these are the most problematical and measures are being taken to control or remove them; 2) Well-established non-native species—these are widespread throughout Ohio, but not as invasive in natural areas as are targeted species; 3) Watch list species—these are not problematical yet, but have potential to become so.

RESULTS

Based upon aerial photo interpretation, we found three major vegetation types: wooded areas, open area, and urban area. Wooded areas were uplands, whereas, open area occupied the central basin. Urban area was a fringe of land encircling the entire site. It ranged from 1.5 to 3.0 m wide and consisted of lawns, sidewalks, and driveways of bare soil. Wooded areas and open area were classified among five vegetation subtypes: wet meadow, emergent marsh, disturbed shrub swamp, disturbed wet forest, and mixed hardwood forest (Fig. 1).

A total of 298 species, varieties, subspecies, and formas of vascular plants were found, representing 173 genera and 71 families (Appendix 1). The most prevalent species within the vegetation subtypes are summarized in Table 1. Ohio natives (Weishaupt 1971) comprised 53.4% of taxa. Twenty-seven species were invasive (10 targeted, 15 well-established, and two on the watch list;

Table 2). According to wetland status, taxa were OBL (6.7%), FACW (16.1%), FAC (32.9%), FACU (13.1%), and either UPL, NI, or without formal designation (31.2%; Reed 1996).

Coefficient-of-conservatism values were assigned to all taxa observed: 9 to 10 (three taxa), 7 or 8 (three taxa), 4 to 6 (38 taxa), and from 1 to 3 (95 taxa). The remaining 159 taxa had values of zero. Using C of C values, we computed FQAI for each vegetation subtype: wet meadow (I = 13.5), emergent marsh (I = 12.7), disturbed shrub swamp (I = 17.3), disturbed wet forest (I = 19.4), and mixed hardwood forest (I = 18.7). Values indicated that habitats were of modest quality, on the scale between 10 (poor) and 50 (excellent) (Andreas and Lichvar 1995).

Values for Shannon diversity index were low: wet meadow = 2.37, emergent marsh = 1.48, disturbed shrub swamp = 2.87, disturbed wet forest = 3.04, and mixed hardwood forest = 2.47. Sites were fairly dissimilar to one another; however, the most similar subtypes were wet meadow and disturbed shrub swamp (Fig. 4). Disturbed wet forest and mixed hardwood forest were also relatively comparable. Emergent marsh was the subtype least similar to the others, having a distinctive, low-diversity flora.

DISCUSSION

The percentage of taxa native to Ohio at the study site was 53.4%. By comparison, a previous study at Fawn Pond (Brecksville, OH) revealed 74.2% native species (Wilder and McCombs 1999), and investigation at Highland Heights Community Park (Highland Heights, OH) indicated 60% native species (Jog and others 2005). In the present study, many non-native species were escapes from cultivation (for example, *Juniperus horizontalis* [creeping juniper], *Pyracantha coccinea* [firethorn], and *Cotoneaster divaricatus* [cotoneaster]). Wilder and McCombs (2003) reported the three species, aforementioned, as new Ohio records.

Probably, humans have inadvertently introduced many escapes to the site. We detected 25 to 30 cases of yard waste dumped at the site during the period of this study. Several species grew within this waste: *Lamium purpureum*, *Viola sororia*, and *Iris* sp. We have not recognized these species herein, because they never became rooted within soil of the site. We speculate that large populations of *Vinca minor*, *Ajuga reptans*, and *Hedera helix* at the site all arose via

TABLE 1

Summary of most prevalent species in plots by vegetation subtype. Percent cover figure is the total percent cover across all plots in the transect. # = number of plots in the transect in which the species occurred, % cov. = percent cover.

Vegetation Subtype	#	% cov.
Wet Meadow - 12 plots		
<i>Typha angustifolia</i>	4	10.9
<i>Frangula alnus</i> – seedlings	10	5.0
<i>Equisetum arvense</i>	11	4.0
Emergent Marsh - 5 plots		
<i>Phragmites australis</i>	5	48.4
<i>Dipsacus sylvestris</i>	2	7.4
<i>Cirsium arvense</i>	5	6.5
Disturbed Shrub Swamp - 10 plots		
Shrub Layer		
<i>Frangula alnus</i>	6	8.4
<i>Malus</i> sp. - small trees	7	5.4
<i>Pinus sylvestris</i>	5	2.6
Herb Layer		
<i>Carex granularis</i>	8	3.9
<i>Scirpus pendulus</i>	8	1.3
<i>Fragaria virginiana</i>	2	1.1
Disturbed Wet Forest - 14 plots		
Tree Layer		
<i>Ulmus americana</i>	11	19.5
<i>Malus</i> sp.	9	7.3
<i>Prunus serotina</i>	6	7.1
Shrub Layer		
<i>Frangula alnus</i>	13	26.0
<i>Viburnum dentatum</i>	8	19.3
<i>Ulmus americana</i> – saplings	3	6.4
Herb Layer		
<i>Frangula alnus</i> – seedlings	7	8.1
<i>Rhamnus cathartica</i> – seedlings	3	3.9
<i>Toxicodendron radicans</i>	1	3.2
Mixed Hardwood Forest - 7 plots		
Tree Layer		
<i>Ostrya virginiana</i>	7	22.4
<i>Fagus grandifolia</i>	4	21.3
<i>Fraxinus americana</i>	4	11.9
Shrub Layer		
<i>Fagus grandifolia</i> – saplings	3	3.1
<i>Carya cordiformis</i> – saplings	2	2.9
<i>Ulmus americana</i> – saplings	1	2.9
Herb Layer		
<i>Toxicodendron radicans</i>	3	20.0
<i>Podophyllum peltatum</i>	2	2.4
<i>Potentilla simplex</i>	1	1.4

TABLE 2

List of invasive species present at Shaker Median Park. Invasive species designations are from Windus and Kroemer 2001.

	Status	Occurrence*
Tree Layer		
<i>Elaeagnus umbellata</i>	Targeted	DWF
Shrub Layer		
<i>Berberis thunbergii</i>	Well-Established	DWF
<i>Frangula alnus</i> P. Mill.	Targeted	DSS, DWF
<i>Ligustrum obtusifolium</i>	Watch List	DWF
<i>Ligustrum vulgare</i>	Well-Established	DWF
<i>Lonicera X bella</i>	Watch List	DWF
<i>Rhamnus cathartica</i>	Targeted	DWF
<i>Rosa canina</i>	Watch List	DWF
<i>Rosa multiflora</i>	Targeted	DSS, DWF
<i>Viburnum opulus</i> var. <i>opulus</i>	Well-Established	DWF, MHF
Herb Layer		
<i>Alliaria petiolata</i>	Targeted	DWF
<i>Cirsium arvense</i>	Well-Established	EM, DWF
<i>Conium maculatum</i>	Well-Established	MHF
<i>Coronilla varia</i>	Well-Established	EM
<i>Daucus carota</i>	Well-Established	EM, DSS, DWF
<i>Dipsacus fullonum</i> L.	Well-Established	EM, DWF
<i>Elymus repens</i>	Well-Established	DWF
<i>Epilobium parviflorum</i>	Well-Established	EM
<i>Frangula alnus</i> P. Mill.	Targeted	WM, DSS, DWF, MHF
<i>Hemerocallis fulva</i>	Well-Established	DWF
<i>Lysimachia nummularia</i>	Well-Established	UR
<i>Lythrum salicaria</i>	Targeted	WM, EM, DSS, DWF
<i>Melilotus alba</i>	Well-Established	EM
<i>Melilotus officinalis</i>	Well-Established	DSS
<i>Phalaris arundinacea</i>	Targeted	EM
<i>Phragmites australis</i>	Targeted	EM
<i>Rhamnus cathartica</i>	Targeted	DWF
<i>Rosa multiflora</i>	Targeted	DSS, DWF
<i>Typha angustifolia</i>	Well-Established	WM, DSS
<i>Viburnum opulus</i> var. <i>opulus</i>	Well-Established	DWF
<i>Vinca minor</i>	Well-Established	DWF

*WM = wet meadow, EM = emergent marsh, DSS = disturbed shrub swamp, DWF = disturbed wet forest, MHF = mixed hardwood forest, DR = urban area.

addition of yard waste.

We also envision that seeds of various species (for example, of *Pyracantha* and *Cotoneaster*) were consumed by birds in residential areas nearby and later deposited at the site, within excrement. This probably accounts for the existence of certain species within the basin.

The vast majority of taxa at the site had a C of C value

of zero. We applied zero-ratings to three categories of species: non-native species, native species that adapt to almost any environment, and invasive species (native or non-native). It is a general rule that species with low C of C values can be found in disturbed areas.

FQAI values of 12.7 to 19.4 signify that habitats at the site were of low to moderate quality. Had solely invasive species entered the site immediately after the

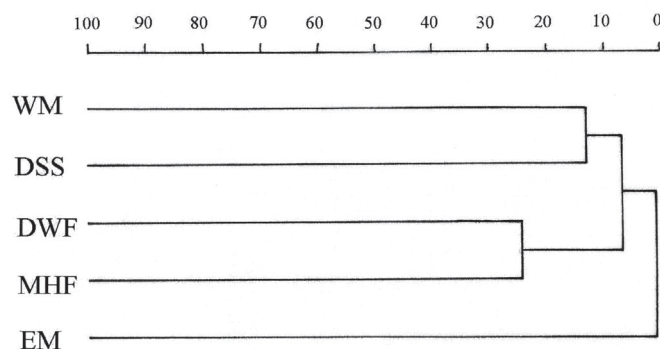


FIGURE 4. Cluster dendrogram of vegetation subtypes. Dendrogram constructed based on Czekanowski's Index of Similarity. The scale indicates percent similarity. WM = wet meadow, DSS = disturbed shrub swamp, DWF = disturbed wet forest, MHF = mixed hardwood forest, EM = emergent marsh.

last major disturbance, values would have been even lower. Values indicate recovery of the site after disturbance. Invasive species were unable to completely dominate the site—a conclusion based on the determination that FQAI was moderate for certain subtypes.

The first plants to inhabit the study site after disturbance presumably belonged to native species such as *Eleocharis rostellata* and *Asclepias tuberosa*, and to escaped species grown elsewhere in cultivation, for example, *Juniperus horizontalis*. We base this conclusion on the abundance of these species at the study site, yet, of few elsewhere in Cuyahoga County. Apparently such species entered the site soon after disturbance and thrived before invasive species could arrive and out-compete them. Now that invasive species, particularly *Frangula alnus* (P. Mill.) (syn = *Rhamnus frangula* L.), are established at the site, the uncommon escaped plants there may cease to thrive.

Wet forest and shrub swamp had higher FQAI values than did the other vegetation subtypes. We conclude that disturbance was either more intense or more recent (or both) in the central basin area than in upland areas. Our conclusion is supported by the circumstance that most soil was removed from the basin area, leaving bedrock exposed in places. Also, fill was added to portions of the basin, most obviously at the eastern end. Recovery might, therefore, be slow in the central basin. Possible, too, is that only competitive *k*-selected species thrive in the areas of shaded forest. Shrub swamp and wet forest are the two largest vegetation subtypes at the site. One might expect community size to correlate positively with species richness, but that Shannon Diversity Index (a measure of evenness) would be independent of these effects. FQAI is also theoretically independent of community size (Andreas and Lichvar 1995).

Values of Shannon Diversity Index mirrored findings pertaining to FQAI. Wet forest scored highest in both indices, followed by shrub swamp, mixed hardwood forest, wet meadow, and emergent marsh, in decreasing order.

Interior-basin areas exhibited more invasive species than did upland areas. The emergent marsh and wet meadow were much smaller and had less vertical

stratification than did the other vegetation subtypes. Perhaps sun-loving invasive species have taken advantage of the minimal stratification to enter these areas and become established. The domination of wet meadow and emergent marsh by invasive species corresponds with the presence within these vegetation subtypes of least diversity and least floristic quality.

The emergent marsh having the lowest Shannon value for vegetation subtypes considered in this study contained *Phragmites australis*. This invasive species covered 48.4% of the transect in the emergent marsh. No other species in this study covered as much area of one transect. *Phragmites australis* grows aggressively and tends to out-compete other species for nutrients, light, etc. (Keller 2000). Thus, we conclude that *P. australis* has suppressed species diversity within the emergent marsh, aforementioned.

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APPENDIX 1

Plant list arranged by families.

LYCOPHYTA		
Lycopodiaceae		
<i>Lycopodium digitatum</i> Dill. ex A. Braun		Fan Ground-Pine
SPHENOPHYTA		
Equisetaceae		
<i>Equisetum arvense</i> L.		Field Horsetail
PTEROPHYTA		
Aspleniaceae		
<i>Asplenium platyneuron</i> (L.) B.S.P.*		Ebony Spleenwort
Dryopteridaceae		
<i>Dryopteris carthusiana</i> (Vill.) H.P. Fuchs		Spinulose Wood Fern
<i>Onoclea sensibilis</i> L.		Sensitive Fern
Ophioglossaceae		
<i>Botrychium</i> Sw. sp. - probably <i>B. dissectum</i> Spreng. var. <i>obliquum</i> (Muhl.) Clute*		Grape Fern
CONIFEROPHYTA		
Cupressaceae		
<i>Juniperus horizontalis</i> Moench		Creeping Juniper
<i>Juniperus</i> L. sp.		Juniper
Pinaceae		
<i>Pinus sylvestris</i> L.		Scotch Pine
Taxaceae		
<i>Taxus cuspidata</i> Sieb. & Zucc.		Japanese Yew
ANGIOSPERMAE: MONOCOTYLEDONEAE		
Alismataceae		
<i>Alisma subcordatum</i> Raf.		American Water-Plantain
Araceae		
<i>Arisaema triphyllum</i> (L.) Schott		Jack-in-the-Pulpit
Cyperaceae		
<i>Carex annectens</i> (Bickn.) Bickn.		Yellow-Fruit Sedge
<i>Carex cristatella</i> Britt.		Crested Sedge
<i>Carex granularis</i> Muhl. ex Willd.		Limestone-Meadow Sedge
<i>Carex hirsutella</i> Mackenzie		Fuzzy-Wuzzy Sedge
<i>Carex lurida</i> Wahlenb.		Sallow Sedge
<i>Carex scoparia</i> Schkuhr ex Willd.*		Pointed Broom Sedge

APPENDIX 1 (*Cont.*)*Plant list arranged by families.*

<i>Carex stipata</i> Muhl. ex Willd.	Stalk-Grain Sedge
<i>Carex swanii</i> (Fern.) Mackenzie	Swan's Sedge
<i>Carex vulpinoidea</i> Michx.	Common Fox Sedge
<i>Eleocharis erythropoda</i> Steud.	Bald Spike-Rush
<i>Eleocharis rostellata</i> (Torr.) Torr.	Beaked Spike-Rush
<i>Schoenoplectus tabernaemontani</i> (K.C. Gmel.) Palla	Soft-Stem Club-Rush
<i>Scirpus atrovirens</i> Willd.	Dark-Green Bulrush
<i>Scirpus pendulus</i> Muhl.	Rufous Bulrush
Iridaceae	
<i>Iris</i> L. sp. - sterile*	Iris
<i>Sisyrinchium angustifolium</i> P. Mill.	Narrow-Leaf Blue-Eyed-Grass
<i>Sisyrinchium montanum</i> Greene	Strict Blue-Eyed Grass
Juncaceae	
<i>Juncus acuminatus</i> Michx.*	Knotty-Leaf Rush
<i>Juncus articulatus</i> L.*	Joint-Leaf Rush
<i>Juncus dudleyi</i> Wieg.	Dudley's Rush
<i>Juncus effusus</i> L.*	Lamp Rush
<i>Juncus gerardii</i> Loisel.	Saltmarsh Rush
<i>Juncus tenuis</i> Willd.	Poverty Rush
<i>Juncus torreyi</i> Coville	Torrey's Rush
Liliaceae	
<i>Allium canadense</i> L.	Meadow Garlic
<i>Allium vineale</i> L.	Crow Garlic
<i>Asparagus officinalis</i> L.*	Garden Asparagus
<i>Erythronium americanum</i> Ker-Gawl.	American Trout-Lily
<i>Mercurialis fulva</i> (L.) L.	Orange Day-Lily
<i>Muscari armeniacum</i> Leichtl. ex Baker	Armenian Grape-Hyacinth
<i>Narcissus pseudonarcissus</i> L.	Common Daffodil
Orchidaceae	
<i>Spiranthes cernua</i> (L.) L.C. Rich ssp. <i>cernua</i>	White Nodding Ladies'-Tresses
<i>Spiranthes cernua</i> (L.) L.C. Rich sensu lato	Nodding Ladies'-Tresses
<i>Spiranthes lucida</i> (H.H. Eat.) Ames	Shining Ladies'-Tresses
Poaceae	
<i>Agrostis gigantea</i> Roth	Black Bent
<i>Andropogon virginicus</i> L.	Broom-Sedge
<i>Aristida oligantha</i> Michx.	Prairie Three-Awn
<i>Dactylis glomerata</i> L.	Orchard Grass
<i>Danthonia spicata</i> (L.) Beauv. ex Roemer & J.A. Schultes	Poverty Wild Oat Grass
<i>Dichanthelium acuminatum</i> (Sw.) Gould & C.A. Clark var. <i>fasciculatum</i> (Torr.) Freckmann	Tapered Rosette Grass
<i>Digitaria ischaemum</i> (Schreb.) Schreb. ex Muhl.*	Smooth Crab Grass
<i>Digitaria sanguinalis</i> (L.) Scop.	Hairy Crab Grass
<i>Echinochloa crus-galli</i> (L.) Beauv.	Large Barnyard Grass
<i>Elymus repens</i> (L.) Gould	Creeping Wild Rye
<i>Eragrostis minor</i> Host	Little Love Grass
<i>Festuca rubra</i> L.	Red Fescue
<i>Glyceria striata</i> (Lam.) A.S. Hitchc.	Fowl Manna Grass
<i>Lolium arundinaceum</i> (Schreb.) S.J. Darbyshire*	Tall Rye Grass
<i>Lolium perenne</i> L.	Perennial Rye Grass
<i>Lolium pratense</i> (Huds.) S.J. Darbyshire	Meadow Rye Grass
<i>Panicum capillare</i> L.	Common Panic Grass
<i>Phalaris arundinacea</i> L.	Reed Canary Grass
<i>Phleum pratense</i> L.	Common Timothy
<i>Phragmites australis</i> (Cav.) Trin. ex Steud.	Common Reed
<i>Poa annua</i> L.*	Annual Blue Grass
<i>Poa compressa</i> L.	Flat-Stem Blue Grass
<i>Poa pratensis</i> L.	Kentucky Blue Grass
<i>Puccinellia tenella</i> (Lang.) Holmb. ssp. <i>langeana</i> (Berlin) Tzvelev*	Tundra Alkali Grass

APPENDIX 1 (*Cont.*)*Plant list arranged by families.*

<i>Sporobolus compositus</i> (Poir.) Merr. var. <i>compositus</i> *	Head-Like Dropseed
Smilacaceae	
<i>Smilax rotundifolia</i> L.	Horsebrier
Typhaceae	
<i>Typha angustifolia</i> L.	Narrow-Leaf Cat-Tail
<i>Typha latifolia</i> L.	Broad-Leaf Cat-Tail
ANGIOSPERMAE: DICOTYLEDONEAE	
Aceraceae	
<i>Acer platanoides</i> L.	Norway Maple
<i>Acer rubrum</i> L.	Red Maple
<i>Acer saccharinum</i> L.	Silver Maple
<i>Acer saccharum</i> Marsh.	Sugar Maple
Anacardiaceae	
<i>Rhus typhina</i> L.	Stag-Horn Sumac
<i>Toxicodendron radicans</i> (L.) Kuntze	Eastern Poison-Ivy
Annonaceae	
<i>Asimina triloba</i> (L.) Dunal	Common Pawpaw
Apiaceae	
<i>Aegopodium podagraria</i> L.	Bishop's Goutweed
<i>Conium maculatum</i> L.	Poison-Hemlock
<i>Daucus carota</i> L. forma <i>epurpuratus</i> Farw.	Queen Anne's-Lace
<i>Daucus carota</i> L. - typical forma	Queen Anne's-Lace
Apocynaceae	
<i>Apocynum cannabinum</i> L.	Indian-Hemp
<i>Vinca minor</i> L.	Lesser Periwinkle
Aquifoliaceae	
<i>Ilex crenata</i> Thunb.	Japanese Holly
<i>Ilex opaca</i> Ait.	American Holly
Araliaceae	
<i>Hedera helix</i> L.	English-Ivy
Asclepiadaceae	
<i>Asclepias incarnata</i> L.	Swamp Milkweed
<i>Asclepias syriaca</i> L.	Common Milkweed
<i>Asclepias tuberosa</i> L.	Butterfly Milkweed
Asteraceae	
<i>Achillea millefolium</i> L.	Common Yarrow
<i>Ambrosia artemisiifolia</i> L.	Annual Ragweed
<i>Antennaria parlinii</i> Fern. ssp. <i>fallax</i> (Greene) Bayer & Stebbins*	Parlin's Pussytoes
<i>Antennaria</i> Gaertn. sp. - possibly <i>A. neglecta</i> Greene*	Pussytoes
<i>Arctium lappa</i> L.	Greater Burdock
<i>Arctium minus</i> Bernh.	Lesser Burdock
<i>Arctium minus</i> (Hill) Bernh. forma <i>pallidum</i> Farw.	Common Burdock
<i>Bellis perennis</i> L.	Lawndaisy
<i>Bidens aristosa</i> (Michx.) Britt.	Bearded Beggarticks
<i>Bidens frondosa</i> L.	Devil's-Pitchfork
<i>Cichorium intybus</i> L.	Chicory
<i>Cirsium arvense</i> (L.) Scop.	Canadian Thistle
<i>Cirsium vulgare</i> (Savi) Ten.	Bull Thistle
<i>Conyza canadensis</i> (L.) Cronq. var. <i>canadensis</i>	Canadian Horseweed
<i>Erichthites hieracifolia</i> (L.) Raf. ex DC.*	American Burnweed

APPENDIX 1 (*Cont.*)*Plant list arranged by families.*

<i>Erigeron annuus</i> (L.) Pers.	Eastern Daisy Fleabane
<i>Erigeron philadelphicus</i> L.	Philadelphia Fleabane
<i>Erigeron strigosus</i> Muhl. ex Willd.*	Prairie Fleabane
<i>Eupatorium altissimum</i> L.	Tall Thoroughwort
<i>Eupatorium perfoliatum</i> L.	Common Boneset
<i>Eupatorium perfoliatum</i> L. forma <i>purpureum</i> Britt.*	Boneset
<i>Euthamia graminifolia</i> (L.) Greene var. <i>graminifolia</i>	Flat-Top Goldentop
<i>Hieracium aurentiacum</i> L.	Devil's-Paintbrush
<i>Hieracium caespitosum</i> Dumort.*	Meadow Hawkweed
<i>Hieracium</i> X <i>flagellare</i> Willd. (pro sp.)	Hawkweed
<i>Hieracium piloselloides</i> Vill.	Tall Hawkweed
<i>Lapsana communis</i> L.*	Common Nipplewort
<i>Leontodon taraxacoides</i> (Vill.) Merat	Lesser Hawkbit
<i>Leucanthemum X superbum</i> (J.W. Ingram) Berg. ex Kent	Ox-Eye Daisy
<i>Leucanthemum vulgare</i> Lam.	Ox-Eye Daisy
<i>Liatris pycnostachya</i> Michx.	Cat-tail Gayfeather
<i>Liatris pycnostachya</i> Michx. X <i>Liatris spicata</i> (L.) Willd.*	Blazing-star
<i>Prenanthes altissima</i> L.	Tall Rattlesnake-Root
<i>Rudbeckia fulgida</i> Ait. var. <i>fulgida</i>	Orange Coneflower
<i>Rudbeckia hirta</i> L.	Black-Eyed-Susan
<i>Rudbeckia hirta</i> L. var. <i>pulcherrima</i> Farw.	Black-Eyed-Susan
<i>Rudbeckia triloba</i> L.	Brown-Eyed-Susan
<i>Solidago altissima</i> L.	Tall Goldenrod
<i>Solidago juncea</i> Ait.	Early Goldenrod
<i>Solidago nemoralis</i> Ait.	Gray Goldenrod
<i>Solidago rugosa</i> P. Mill.	Wrinkle-Leaf Goldenrod
<i>Sonchus asper</i> (L.) Hill	Spiny-Leaf Sow-Thistle
<i>Sonchus asper</i> (L.) Hill forma <i>inermis</i> (Bisch.) G. Beck*	Spiny-leaved Sowthistle
<i>Symphyotrichum lanceolatum</i> (Willd.) Nesom ssp., ssp. <i>lanceolatum</i> var. <i>lanceolatum</i>	White Panicked American-Aster
<i>Symphyotrichum lateriflorum</i> (L.) A. & D. Love var. <i>lateriflorum</i>	Farewell-Summer
<i>Symphyotrichum novae-angliae</i> (L.) Nesom	New England American-Aster
<i>Symphyotrichum pilosum</i> (Willd.) Nesom var. <i>pilosum</i> *	White Oldfield American-Aster
<i>Taraxacum officinale</i> G.H. Weber ex Wiggers	Common Dandelion
<i>Tussilago farfara</i> L.	Colt's-Foot
<i>Vernonia gigantea</i> (Walt.) Trel. ssp. <i>gigantea</i>	Giant Ironweed
Berberidaceae	
<i>Berberis thunbergii</i> DC.	Japanese Barberry
<i>Mabonia aquifolium</i> (Pursh) Nutt.	Holly-Leaf Oregon-Grape
<i>Podophyllum peltatum</i> L.	May-Apple
Betulaceae	
<i>Betula pendula</i> Roth	European Weeping Birch
<i>Ostrya virginiana</i> (P. Mill.) K. Koch	Eastern Hop-Hornbeam
Brassicaceae	
<i>Alliaria petiolata</i> (Bieb.) Cavara & Grande	Garlic-Mustard
<i>Barbarea vulgaris</i> R. Br. var. <i>arcuata</i> (Opiz.) Fries	Yellow-Rocket
<i>Barbarea vulgaris</i> Ait. f. var. <i>vulgaris</i>	Garden Yellow-Rocket
<i>Cardamine concatenata</i> (Michx.) Sw.	Cut-Leaf Toothwort
<i>Lepidium virginicum</i> L.	Poorman's-Pepperwort
Buxaceae	
<i>Pachysandra terminalis</i> Sieb. & Zucc.	Japanese Mountain-Spurge
Cannabinaceae	
<i>Cannibis sativa</i> L.*	Hemp
Caprifoliaceae	
<i>Lonicera X bella</i> Zabel	Honeysuckle
<i>Lonicera japonica</i> Thunb.*	Japanese Honeysuckle
<i>Lonicera maackii</i> (Rupr.) Herder*	Amur Honeysuckle

APPENDIX 1 (*Cont.*)*Plant list arranged by families.*

<i>Lonicera ruprechtiana</i> Regel	Manchurian Honeysuckle
<i>Lonicera</i> L. sp. - not <i>L. maackii</i> *	Honeysuckle
<i>Viburnum dentatum</i> L.	Southern Arrow-Wood
<i>Viburnum lantana</i> L.	Wayfaring-Tree
<i>Viburnum lentago</i> L.*	Nanny-Berry
<i>Viburnum opulus</i> L. var. <i>opulus</i>	Highbush-Cranberry
<i>Viburnum prunifolium</i> L.*	Smooth Blackhaw
<i>Viburnum recognitum</i> Fern.*	Smooth Arrow-Wood
Caryophyllaceae	
<i>Cerastium fontanum</i> Baumg.	Common Mouse-Ear Chickweed
<i>Spergularia maritima</i> (All.) Choiv.	Satin-Flower
Chenopodiaceae	
<i>Atriplex bastata</i> L.*	Orache
<i>Atriplex patula</i> L.*	Halberd-Leaf Orache
<i>Atriplex</i> L. sp.	Orache
<i>Chenopodium album</i> L.	Lamb's-Quarters
<i>Chenopodium glaucum</i> L.*	Oak-Leaf Goosefoot
Clusiaceae	
<i>Hypericum perforatum</i> L.	Common St. John's-Wort
<i>Hypericum prolificum</i> L.	Shrubby St. John's-Wort
Convolvulaceae	
<i>Calystegia sepium</i> (L.) R. Br. ssp. <i>sepium</i>	Hedge False Bindweed
Cornaceae	
<i>Cornus amomum</i> P. Mill.	Silky Dogwood
<i>Cornus florida</i> L.	Flowering Dogwood
<i>Cornus racemosa</i> Lam.*	Gray Dogwood
<i>Cornus sericea</i> L. ssp. <i>sericea</i>	Redosier
Dipsacaceae	
<i>Dipsacus fullonum</i> L.	Fuller's Teasel
Elaeagnaceae	
<i>Elaeagnus umbellata</i> Thunb.	Autumn-Olive
Euphorbiaceae	
<i>Chamaesyce maculata</i> (L.) Small	Spotted Sandmat
Fabaceae	
<i>Coronilla varia</i> L.	Purple Crown-Vetch
<i>Lotus tenuis</i> Waldst. & Kitt. ex Willd.	Narrow-Leaf Bird's-Foot Trefoil
<i>Medicago lupulina</i> L.	Black Medick
<i>Melilotus alba</i> Desr.	White Sweet-Clover
<i>Melilotus officinalis</i> (L.) Lam.	Yellow Sweet-Clover
<i>Robinia pseudoacacia</i> L.	Black Locust
<i>Trifolium hybridum</i> L.	Alsike Clover
<i>Trifolium pratense</i> L.	Red Clover
<i>Trifolium repens</i> L.	White Clover
Fagaceae	
<i>Fagus grandifolia</i> Ehrh.	American Beech
<i>Quercus palustris</i> Muenchh.	Pin Oak
<i>Quercus rubra</i> L. var. <i>ambigua</i> (Gray) Fern.	Northern Red Oak
Geraniaceae	
<i>Geranium</i> sp. L. - sterile*	Cranesbill
Hippocastanaceae	
<i>Aesculus hippocastanum</i> L.	Horse-Chestnut

APPENDIX 1 (*Cont.*)*Plant list arranged by families.*

Juglandaceae	
<i>Carya cordiformis</i> (Wangenh.) K. Koch	Bitter-Nut Hickory
Lamiaceae	
<i>Ajuga reptans</i> L.	Carpet Bugle
<i>Glechoma hederacea</i> L. var. <i>micrantha</i> Moric.	Groundivy
<i>Hedeoma pulegioides</i> (L.) Pers	American False Pennyroyal
<i>Leonurus cardiaca</i> L.	Motherwort
<i>Lycopus americanus</i> Muhl. ex W. Bart.	Cut-Leaf Water-Horehound
<i>Lycopus virginicus</i> L.*	Virginia Water-Horehound
<i>Melissa officinalis</i> L.*	Lemonbalm
<i>Mentha spicata</i> L.*	Spearmint
<i>Physostegia virginiana</i> (L.) Benth.	Obedient-Plant
<i>Physostegia virginiana</i> Benth. var. <i>alba</i> Hort.	Obedient-Plant
<i>Prunella vulgaris</i> L.	Common Selfheal
<i>Pycnanthemum tenuifolium</i> Schrad.	Narrow-Leaf Mountain-Mint
Lythraceae	
<i>Lythrum salicaria</i> L.	Purple Loosestrife
Malvaceae	
<i>Malva alcea</i> L.	Vervain Mallow
Myricaceae	
<i>Morella pensylvanica</i> (Mirbel) Kartesz	Northern Bayberry
Oleaceae	
<i>Chionanthus virginicus</i> L.	White Fringetree
<i>Fraxinus americana</i> L. var. <i>americana</i>	White Ash
<i>Fraxinus pennsylvanica</i> Marsh. var. <i>subintegerrima</i> (Vahl.) Fern.	Green Ash
<i>Ligustrum obtusifolium</i> Sieb. & Zucc.	Border Privet
<i>Ligustrum vulgare</i> L.	European Privet
<i>Syringa vulgaris</i> L.	Common Lilac
Onagraceae	
<i>Circaea lutetiana</i> L.	Broad-Leaf Enchanter's-Nightshade
<i>Epilobium coloratum</i> Biehler*	Purple-Leaf Willowherb
<i>Epilobium parviflorum</i> Schreb.	Small-Flower Hairy Willowherb
<i>Oenothera biennis</i> L.	King's-Cureall
<i>Oenothera fruticosa</i> L.	Narrow-Leaf Evening-Primrose
<i>Oenothera perennis</i> L.*	Small Evening-Primrose
Orobanchaceae	
<i>Epifagus virginiana</i> (L.) W. Bart.	Beechdrops
Oxalidaceae	
<i>Oxalis stricta</i> L.	Upright Yellow Wood-Sorrel
Phytolaccaceae	
<i>Phytolacca americana</i> L.	American Pokeweed
Plantaginaceae	
<i>Plantago lanceolata</i> L.	English Plantain
<i>Plantago major</i> L.	Great Plantain
Polygonaceae	
<i>Polygonum aviculare</i> L.	Yard Knotweed
<i>Polygonum pensylvanicum</i> L.*	Pinkweed
<i>Polygonum punctatum</i> Ell.*	Dotted Smartweed
<i>Polygonum persicaria</i> L.	Lady's-Thumb
<i>Polygonum virginianum</i> L.	Jumpseed
<i>Rumex acetosilla</i> L.	Common Sheep Sorrel

APPENDIX 1 (*Cont.*)*Plant list arranged by families.*

<i>Rumex crispus</i> L.	Curly Dock
<i>Rumex obtusifolius</i> L.	Bitter Dock
Portulacaceae	
<i>Portulaca oleracea</i> L.	Little Hogweed
Primulaceae	
<i>Anagallis arvensis</i> L.	Scarlet Pimpernel
<i>Lysimachia ciliata</i> L.	Fringed Yellow-Loosestrife
<i>Lysimachia nummularia</i> L.	Creeping-Jenny
Ranunculaceae	
<i>Aquilegia vulgaris</i> L.	European Columbine
<i>Ranunculus acris</i> L.	Tall Buttercup
Rhamnaceae	
<i>Frangula alnus</i> P. Mill.	Glossy False Buckthorn
<i>Rhamnus cathartica</i> L.	European Buckthorn
<i>Rhamnus frangula</i> L. var. <i>asplenifolia</i> Dipp.	Buckthorn
Rosaceae	
<i>Agrimonia gryposepala</i> Wallr.	Tall Hairy Grooveburr
<i>Agrimonia parviflora</i> Ait.*	Harvestlice
<i>Amelanchier arborea</i> (Michx. f.) Fern.	Downy Service-Berry
<i>Cotoneaster divaricatus</i> Rehd. & Wilson	Spreading Cotoneaster
<i>Crataegus mollis</i> Scheele	Downy Hawthorn
<i>Crataegus monogyna</i> Jacq.	English Hawthorn
<i>Crataegus pedicellata</i> Sarg.	Scarlet Hawthorn
<i>Crataegus punctata</i> Jacq.	Dotted Hawthorn
<i>Fragaria virginiana</i> Duchesne*	Virginia Strawberry
<i>Geum canadense</i> Jacq.	White Avens
<i>Geum laciniatum</i> Murr.	Rough Avens
<i>Malus pumila</i> P. Mill.*	Cultivated Apple
<i>Potentilla recta</i> L.	Sulphur Cinquefoil
<i>Potentilla simplex</i> Michx.	Oldfield Cinquefoil
<i>Prunus avium</i> (L.) L.*	Sweet Cherry
<i>Prunus serotina</i> Ehrh.	Black Cherry
<i>Prunus virginiana</i> L.	Choke Cherry
<i>Pyracantha coccinea</i> M. Roemer	Scarlet Firethorn
<i>Rosa canina</i> L.	Dog Rose
<i>Rosa multiflora</i> Thunb. ex Murr.	Rambler Rose
<i>Rosa setigera</i> Michx.	Climbing Rose
<i>Rosa</i> L. sp. - cultivated hybrid	Rose
<i>Rubus occidentalis</i> L.*	Black Raspberry
<i>Rubus pensilvanicus</i> Poir.	Pennsylvania Blackberry
<i>Sorbus aucuparia</i> L.	European Mountain-Ash
Salicaceae	
<i>Populus alba</i> L.	White Poplar
<i>Populus deltoides</i> Bartr. ex Marsh.	Eastern Cottonwood
<i>Populus grandidentata</i> Michx.	Big-Tooth Aspen
<i>Salix alba</i> L.	White Willow
<i>Salix atrocinerea</i> Brot.	Smooth-Twig Gray Willow
<i>Salix caprea</i> L.	Goat Willow
<i>Salix discolor</i> Muhl.	Pussy Willow
<i>Salix eriocephala</i> Michx.	Missouri Willow
<i>Salix purpurea</i> L.	Purple Willow
<i>Salix</i> X <i>rubens</i> Schrank. (pro sp.)*	Hybrid Crack Willow
<i>Salix</i> X <i>sepulcralis</i> Simonkai	Willow
Scrophulariaceae	
<i>Penstemon digitalis</i> Nutt. ex Sims	Foxglove Beardtongue

APPENDIX 1 (*Cont.*)*Plant list arranged by families.*

<i>Verbascum thapsus</i> L.	Great Mullein
<i>Veronica chamaedrys</i> L.	Germander Speedwell
<i>Veronica filiformis</i> Sm.	Thread-Stalk Speedwell
<i>Veronica officinalis</i> L.	Common Gypsyweed
<i>Veronica serpyllifolia</i> L.	Thyme-Leaf Speedwell
Solanaceae	
<i>Solanum dulcamara</i> L.	Climbing Nightshade
Tiliaceae	
<i>Tilia americana</i> L. var. <i>americana</i>	American Basswood
Ulmaceae	
<i>Ulmus americana</i> L.*	American Elm
Verbenaceae	
<i>Verbena hastata</i> L.	Simpler's-Joy
<i>Verbena urticifolia</i> L.	White Vervain
Vitaceae	
<i>Parthenocissus quinquefolia</i> (L.) Planch.	Virginia-Creeper
<i>Vitis aestivalis</i> Michx. var. <i>aestivalis</i>	Summer Grape
<i>Vitis aestivalis</i> Michx. var. <i>bicolor</i> Deam	Summer Grape
<i>Vitis labruscana</i> Bailey	Grape
<i>Vitis riparia</i> Michx.	River-Bank Grape
